POLIOMYELITIS

It is an acute viral infection caused by polio virus (RNA virus). Polio virus has three sero types—Type I, Type II and Type III. Polio is mainly the infection of gastrointestinal tract (GIT), but in 1% of the cases, the virus invades central nervous system and causes various degrees of paralysis or even death.

Problem Statement

Before the introduction of vaccination, polio was present all over the world. Vaccination was started in 1954. Now polio is virtually eliminated from the developed world. (In september 1994, the western hemisphere is certified as a region free from poliomyelitis.)

Now in India, polio is on the verge of eradication. Cases reported in the country decreased from 26,000 (in 1988) to 2800 (in 1999). Most of these cases are reported from four states only (Bihar, UP, Delhi, West Bengal).

Estimation of the Magnitude of the Problem (Incidence and prevalence)

Lameness surveys in children in 5–10 years age group are taken to find out poliomyelitis prevalence. Lower extremities are the most commonly affected parts in paralytic polio. So, ameness survey in children 5–10 years age group (easily approachable group) will give us rough data of prevalence of polio. The prevalence so detected is multiplied by 1.25 will give us better estimate of prevalence of polio. This 0.25 extra is to include those having paralysis of other parts of the body (i.e., other than lower limbs). This prevalence divided by five (because there are five one-year groups) will give annual incidence of polio.

Finally, the prevalence and incidence of polio thus calculated, is multiplied by 1.33, will give more accurate estimate. This is done to include those who have migrated, recovered or dead.

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Epidemiology

1. **Agent factors**

a) **Agent**: The virus belongs to enterovirus, picorna group. Polio virus has three sero types—type I, type II and type III. Most outbreaks are due to type I virus. They can survive outside the body for longer periods (in water four months and in faeces six months). But these are killed by pasteurisation and chlorination 0.3 to 0.5 ppm strength.

Virus first multiply in the wall of small gut and then selectively affect (only 1% of cases) the motor neurons of CNS which results in flaccid paralysis.

b) **Reservoir of infection**: Man is the only known reservoir. Most infections are subclinical. Mild and subclinical cases play an important role in the spread of disease.

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Among children, for every clinical case there are 1000 subclinical cases and among adults for every clinical case there are 75 subclinical cases in the community.

c) **Infectious material**: virus is mainly found in faeces and oropharyngeal secretions of the infected person.

d) **Period of communicability**: 7–10 days before the onset of symptoms and two weeks after the symptoms.

2. **Host factor**
   a) **Age**: Polio mainly occurs among children in the age group between six months to three years. Now, because of good immunization coverage the age group is further widened up to six years.
   b) **Sex**: More in males (three males for one female).
   c) **Immunity**: During the first six months maternal antibodies protect the child. Immunity after infection is good. But this immunity is type specific. They may be affected by other types of virus.

3. **Environmental factors**
   Polio occurs most commonly in rainy seasons. So epidemics occur during June to september. Overcrowding, poor environmental sanitation, contaminated food and water are the main causes of the spread of the disease.

4. **Precipitating factors**
   Though children are *at risk group,* precipitating factors for paralysis play a major role and these are trauma, muscle strain, surgical procedures (mainly tonsillectomy and dental extraction) during polio epidemics. Intramuscular injection (mainly DPT) during epidemics will favour the disease occurrence.

Mode of Transmission

1. Transmission is mainly faeco-oral route.
2. Droplet infection (less common) mainly in acute phase when the virus is present in the throat.

Incubation Period

7–14 days (but ranges from 3–35 days).

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Pathogenesis

The virus after entering the intestine, penetrates the intestinal mucosa. From there it spreads to regional lymph nodes. In some patients further multiplication at these sites leads to viraemia which coincides with the onset of fever. Virus may then localise in meninges causing meningitis and less frequently in the motor nuclei of the spinal cord or brain causing poliomyelitis or polioencephalitis.

Clinical Features

The outcome of the illness may be:

1. Asymptomatic infection (95% of cases)
2. Short nonspecific febrile illness (4% of cases)
3. Meningitis without paralysis (1% of cases)
4. Paralytic polio (0.1 to 1% of cases).

First two outcomes are mild and not important.

Meningitis and Poliomyelitis

Those infected suffer acutely from fever, headache, vomiting and signs of meningeal irritaton. In many cases, the disease does not progress further.

But in others, muscular pain followed by flaccid paralysis develops. The paralysis is asymmetrical in distribution and may continue to spread for several days until patient's temperature returns to normal. Sensory changes do not occur. The legs and to a lesser extent the arms are mostly affected.

When the brainstem nuclei are involved, bulbar paralysis with weakness of swallowing and coughing develops. Sometimes it may lead to death.

Complications

Respiratory failure occurs from paralysis of the muscles of respiration, which is one of the commonest cause of death.

Prevention

1. Primary prevention
   a) Health promotion
   b) Specific protection
2. Secondary prevention: Early diagnosis and treatment

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3. Tertiary prevention
   a) Disability limitation
   b) Rehabilitation

a) **Health promotion**: Aims at improving the general standards of living and advocating lifestyles which will prevent polio. Providing facilities for healthful environment and good nutritional status of the community. These will improve the resistance power of the people.

Following are the steps to be taken for the promotion of good health

i) Healthful physical environment (good housing, potable water supply, sanitary disposal of excreta etc)
ii) Improvement of nutritional standards of the community.
iii) Health education (prevention of polio, immunization etc)

b) **Specific protection (By immunization)**

For immunization, two types of vaccines are available.

i) Inactivated (Salk) polio vaccine.
ii) Oral polio vaccine (Sabin vaccine).
   Most commonly used vaccine is OPV. This vaccine was found by Sabin in 1957.

OPV

It is a live attenuated vaccine. Three types which are mainly associated with epidemics (type I, type II and type III) are grown in monkey kidney or human diploid cell culture.

So the vaccine contains:
3 lakh $TCID_{50}$ of Type I
1 lakh $TCID_{50}$ of Type II
3 lakh $TCID_{50}$ of Type III
(TCID means tissue culture infective dose).

1. **Storage**:*Stabilized vaccine* 4^0C (active for one year), at room temperature (active for one month). Non-stabilised vaccine: -20^0C is ideal.
2. **Dose**: 2 or 3 drops (If the child spits, repeat it).
3. Route of administration: oral.
4. **Number of doses**: Three doses at monthly intervals (starting from the 6th week of the child, i.e., 6th wk, 10th wk, 14th wk). Fourth dose (or first booster dose) at eighteenth month of the child.

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5. **Action**: The attenuated virus multiplies in Peyer's patches of intestine leading to viraemia. It produce antibodies. Intestinal infection (with OPV) stimulates the production of IgA secretory antibodies. This will prevent subsequent infection. So it produces both local and systemic immunity. These attenuated virus after multiplying in the intestine are excreted in faeces and infect the community. Thereby they provide immunity to others also. This is called *herd immunity*.

Duration of immunity—May be life long.

Advantages of OPV

1. Easy to administer.
2. Antibody production is quick.
3. Useful in epidemics (IPV is not advised in epidemics).
4. Cheap.
5. It gives both humoral and intestinal immunity.
6. It gives herd immunity (vaccine virus and gives immunity to others also).

Contra Indications

1. Acute and severe infection (mild and moderate infections are not contra-indications).
2. Leukaemia and malignancies.
3. Prolonged use of corticosteriods.
4. AIDS patients.

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IPV (*Salk vaccine*)

It is also called inactivated polio vaccine or injectable polio vaccine. It is a killed vaccine. IPV is given in three doses. Route of administration is subcutaneous. It should be given at an interval of four weeks with a booster after one year. Thereafter repeat it for every three years. It gives protection against paralysis, but infection can occur again in the same patient (because no local immunity).

Table 4.2 Differences between OPV and IPV

IPV	OPV
1. Given IM or subcutaneous	1. Given orally
2. Killed vaccine	2. Live attenuated vaccine
3. No local immunity	3. Gives both humoral and local immunity

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IPV	OPV
4. Not useful in epidemics	4. Useful in epidemics
5. Difficult to manufacture	5. Easy to manufacture
6. Costly	6. Cheap
7. Does not require strict storage conditions	7. Nonstabilised vaccine needs strict storage conditions.
8. Useful for AIDS and immunosupressed people	8. Not useful for AIDS and immuno-suppressed people.

1. **Passive immunization**
   For passive immunization we use normal human immunoglobulin. Dose = 0.25 to 0.3 mL/kg body weight. Immunization with OPV has virtually eliminated the use of passive immunization.

2. **Secondary prevention (Early diagnosis and treatment)**
   Complete bedrest up to control of fever and pain during the early stages. Intramuscular injection should be avoided during illness. If respiratory failure develops, ventilatory support is advised.

3. **Tertiary prevention**
   a) **Disability limitation**: (It is advised during early stages of disease)
      i) Complete bed rest (avoid exercises, massage, injections during the illness).
      ii) Give nourishing food.
      iii) Proper positioning of the body (to prevent bedsores).
   b) **Rehabilitation** (It is advised during later stages of disease)
      i) Continue proper positioning
      ii) Range of motion (ROM) exercises, active games
      iii) Swimming and cycling
      iv) If deformity present, orthopaedic aid can help.
      v) Sometimes reconstructive surgery is needed.

Pulse Polio Immunization

It is the largest public health event conducted in a single country. The aim of PPI is giving polio drops to all under five years children on two immunization days (six weeks apart) on the same days all over the country.

Like a pulse that appears at regular intervals, the immunization is given on the same day all over the country at regular intervals (i.e., interval between two doses of PPI is six weeks).

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Here are some programs related to polio:

Pulse Polio Immunization Programme

The Indian government's program to eradicate polio by vaccinating children unde five years old with polio drops. The program began in 1995 and was preceded by a large-scale vaccination campaign in Delhi on Gandhi Jayanti in 1994. The last case of wild polio in India was reported on January 13, 2011.

National immunization program (EPI)

India's national immunization program includes the oral polio vaccine. The program's goals include reducing polio-related morbidity and mortality, and making vaccination services available to all eligible children and pregnant women.

Gates Foundation

The Gates Foundation works to improve data access, track progress, and guide the development of vaccines and diagnostic tools.

OpenWHO course

The OpenWHO offers a course on poliomyelitis and the Global Polio Eradication Initiative. Participants who achieve more than 80% in the course quizzes can earn a certificate.

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